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Factors Affecting Public School Expenditures in Ohio

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INTRODUCTION

The objective of this study is to estimate the impact of various factors on public school expenditures of Ohio school districts. The analysis focuses on the operational efficiency of school districts. Capital and transportation costs are not analyzed because collection of adequate data to analyze these costs was beyond the scope of this study. Measures of school quality are included in the analysis, but they are not comprehensive measures of quality. As a result, the implications of the quality variables are limited.

Total public school expenditures have risen rapidly from increases in enrollment and increases in expenditures per student. While support from state and federal sources has increased, the major source of school revenues is still the local property tax. With future increases in school expenditures likely, it is important to study the efficiency of school systems. Are there economies from increasing the size of schools or school districts? What are the factors which have major impacts on costs? Of these, which are subject to control by school boards? What influences the level of expenditures provided to schools by the residents of a school district?

Several conclusions emerge from the results of this study. First, Ohio school districts have largely exhausted economies of scale through consolidation. While a number of school districts may still be able to gain from consolidation, and some districts will gain administrative efficiencies by moving to county school districts, the potential gain from these changes in Ohio as a whole will be relatively small. Since teacher salaries are the major component of school operating expenditures, class size and the training and experience of the teaching staff are the most important factors affecting school costs. While school boards have some control over teaching staff, they must exercise care in making changes in the teaching staff because of the potential changes in school quality which may result. Unfortunately, little is known about the tradeoffs among school quality, class size, and teacher ability. Finally, taxable property, income, and education levels in the school district are impor-

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tant determinants of the level of expenditures provided to the schools. These and other results of the study are developed and analyzed in the remainder of this paper.

THE OHIO PUBLIC SCHOOL SYSTEM

Expenditure and enrollment trends in the Ohio public school system, presented in Tables 1 and 2, show rapid increases since 1949-50, with stabilization of enrollment since 1970. The rate of school consolidation also has been greatly reduced since 1970. The three types of districts, city, exempted village, and local, are similar in tax structure, state and federal aid, and composition. All types are dominated by multiplant districts as opposed to single-plant districts. Even the local districts currently have a mean average daily membership in excess of 2,000 students. Several local districts include an entire county.

One difference is that city districts have greater enrollment and expenditures per pupil than the other two classes. A second difference is that city and exempted village districts operate independently of county boards of education and provide all school services. Local districts are subject to and receive some services from their respective county boards. In the expenditure data, however, the costs of services provided by county boards of education are allocated to the local districts to make expenditures comparable to those in city and exempted village districts.

The main data base for the statistical analysis consists of the 646 school districts at the end of the 1968-69 school year. Of these, five districts were deleted because of incomplete data and three were deleted because they represented special situations. The data are drawn from four annual reports which each school district completes for the State Department of Education, plus a special survey on racial composition

TABLE 1.—Operating Expenditures per Pupil, by Type of District, Ohio.

Year	City	Exempted Village	Local	State
1949-50	$ 207.35	$169.04	$169.53	$ 190.02
1954-55	266.56	226.72	220.61	247.43
1959-60	351.46	311.72	312.92	330.67
1964-65	422.44	389.11	381.78	406.58
1968-69	644.22	562.93	552.39	608.25
1969-70	718.99	588.80	594.41	677.87
1974-75	1,140.84	933.83	920.64	1,078.90

Source: (7, 1975, p. vi).

Note: Excludes expenditures for capital outlay, debt retirement, and interest. There are, in addition, variations in the definition of operating expenditures from year to year as to which federal and state programs are included. In more recent years, the definition has been made more consistent with national accounting definitions.

TABLE 2.—Student Enrollment Trends by Type of District, Ohio.

Year	City			Exempted Village			Local			State		
	ADM (1,000)	No. of Districts	ADM District	ADM (1,000)	No. of Districts	ADM District	ADM (1,000)	No. of Districts	ADM District	ADM (1,000)	No. of Districts	ADM District
1949-50	646.5	113	5,721	90.2	89	1,014	445.5	NA	NA	1,182.2	NA	NA
1954-55	856.7	135	6,346	99.6	81	1,230	544.4	NA	NA	1,500.7	NA	NA
1959-60	1,067.2	141	7,568	119.7	77	1,555	653.7	710	921	1,840.6	928	1,983
1964-65	1,330.5	159	8,368	114.9	62	1,853	769.5	533	1,444	2,214.9	754	2,938
1968-69	1,380.7	168	8,218	100.1	50	2,003	807.8	428	1,887	2,288.6	646	3,543
1969-70	1,451.2	171	8,487	107.4	50	2,148	839.9	417	2,014	2,398.5	638	3,759
1974-75	1,365.9	182	7,505	106.4	49	2,171	823.7	386	2,134	2,296.0	617	3,721

Sources: (6, 7).

Notes: ADM=average daily membership. NA=not available; Nos. of local districts are not available for 1949-50 and 1954-55, precluding computation of ADM/District for local and state in these years. Kindergarten ADM is not included for some years, is fully included for others, and is included at 0.5 for the remainder.

of school districts completed during 1968-69. Since the size and number of Ohio school districts have not changed greatly since 1968-69, except for cost levels this data base is still highly representative of Ohio school districts in 1976.

Characteristics of the Ohio school system for the 1968-69 school year are presented in Table 3. Enrollment in Spring 1969 ranged from 86 to 144,975 students. Operating expenses ranged from $395 to $1,380 per student. The operating portion of transportation costs, included in operating expenses, averaged $13, $20, and $31, respectively, in city, exempted village, and local districts.

A shortcoming of the school district data is the inability to control for the extent of vocational education among school districts. Vocational education is a significant part of the programs of many districts in Ohio. Information from the recently established joint vocational school districts in Ohio provides an opportunity to examine the costs of vocational education in these districts. Cost and enrollment data for

TABLE 3.—Characteristics of Ohio Public School Districts, 1968-69 (Mean with Standard Deviation in Parentheses).

	State	City	Exempted Village	Local
Enrollment, Spring	3,693	8,478	2,087	1,971
(Students/District)	(9,021)	(16,513)	(1,557)	(1,511)
Operating Expenses ($/Student)	569	616	546	553
	(107)	(123)	(99)	(95)
Property Tax Value/Student	14,178	16,979	13,449	13,144
($/Student)	(9,893)	(9,550)	(7,066)	(10,116)
White/Total Students	0.965	0.932	0.972	0.977
	(0.082)	(0.108)	(0.052)	(0.068)
Average Daily Attendance / Average Daily Membership	0.945	0.943	0.948	0.946
	(0.012)	(0.010)	(0.008)	(0.013)
Enrollment, Spring 1969 / Enrollment, Autumn 1968	0.990	0.989	0.990	0.990
	(0.046)	(0.013)	(0.019)	(0.055)
Enrollment, Spring 1969 / Enrollment, Spring 1967	1.043	1.036	1.039	1.046
	(0.061)	(0.056)	(0.060)	(0.063)
Teacher/Pupil Ratio	0.047	0.047	0.046	0.047
	(0.009)	(0.005)	(0.005)	(0.011)
Masters' Degree Teachers / Total Teachers	0.186	0.246	0.199	0.161
	(0.083)	(0.083)	0.094)	(0.068)
More Than 10 Years' Experience / Total Teachers	0.398	0.431	0.415	0.383
	(0.099)	(0.103)	(0.085)	(0.096)

these districts are presented in Table 4. Operating expenses per pupil are significantly greater in joint vocational districts than in the regular districts.

A joint vocational school district is formed by a cooperative agreement of several regular school districts to provide the vocational education programs for those districts. Vocational students are enrolled in their regular district, but attend the vocational school. The joint vocational school is generally financed by a special property tax levy. Generally, these schools provide vocational programs for high school juniors and seniors in five areas: agricultural education, business office education, distributive education, home economics, and trade and industrial services. About 50 percent of joint vocational school enrollment has been in trade and industrial services.

A SCHOOL EXPENDITURE FUNCTION

Based on theoretical considerations and previous work, the expenditure function estimated in this study is:

$Y = f$ (Enroll, Wealth, School Inputs, Student Characteristics) (1)

Two measures of expenditures (Y) are used:

Y_1=operating expenses ($ per student in average daily membership); this includes general control, instruction, plant operation, attendance, health, transportation, and fixed charges expenses

$Y_2 = Y_1$ — transportation expenses/student in average daily membership.

Since the major interest of this study is economies of school operations, the measure Y_2 is used in most equations. Transportation expenses are an important factor limiting the expansion of many local districts (4). However, transportation costs include capital costs in addition to the operating expense component and depend on the dispersion

TABLE 4.—Characteristics of Joint Vocational School Districts in Ohio.

Year	Operating Expenditures per Pupil ($)	ADM	No. of Districts	ADM / District
1969-70	1,199.83	8,779	15	585
1970-71	1,222.73	10,562	15	704
1971-72	1,352.67	13,415	19	706
1972-73	1,396.59	17,078	22	776
1973-74	1,532.68	21,834	25	873
1974-75	1,625.39	27,045	30	902

Source: (7).
Note: ADM=average daily membership.

of students and the number of school buildings in the district. Information on this and building capital costs were beyond the scope of this study.

The size of each district is measured by: Enroll = enrollment in Spring 1969 (1,000 students).

Cohn (1), Hanson (2), Katzman (5), and Riew (8) found significant economies of scale in school operations, while Hirsch (3) did not. Several found diseconomies of scale beyond an optimum sized unit. Cohn (1), in his study of Iowa high school districts, found minimum cost operation at 1,500-2,200 students. His sample, although at the district level, is dominated by single-plant school districts. Riew (8), in his study of single-plant high school districts in Wisconsin, found minimum cost operation at 1,675 students. Katzman (5) found minimum cost enrollment levels of 1,400 to 1,800 students for multiplant elementary districts in Boston.

Hanson (2), for school districts in several states, found optimum school district size had a median of about 50,000 students, with a range from 20,000 in Nebraska to 160,000 in New York. Hanson differs from the other studies because his is a study of district operations and includes large city school systems.

The primary impact of district Wealth is on the demand for education. Three measures of Wealth are used:

Tax Val=Taxable value of real property per student in average daily membership ($1,000)

Med Inc.=Median income of the county in which the district is located from the 1960 Census of Population ($1,000)

Med Ed.=Median education of the county in which the district is located from the 1960 Census (years of school).

Since the property tax is the major source of school revenues, Tax Val is a proxy for the price per unit of education. The greater is Tax Val, the lower is the tax rate or price needed to finance a given level of education. Tax Val is expected to have a positive impact on school expenditures per student. The median income and education of a district are measures of district income. Both are expected to have positive impacts on expenditures. Hirsch (3) found that assessed value of real property per student and per capita income both had positive impacts on school expenditures in St. Louis County. Katzman (5) reviews several studies which examine the relationship between school expenditures and district characteristics.

Conceptually, prices of School Inputs standardized for quality are needed in equation (1). Since these prices are not available, quantita-

tive measures of School Inputs must be used. The School Input measures used are:

District=1 for a city district, 2 for exempted village, and 3 for local

Mas/TOT=The percent of teachers with Masters' degrees in total teachers

ND/TOT=The percent of teachers without Bachelors' degrees in total teachers

Exp., 1-5=The percent of teachers with 1-5 years of experience in total teachers

Exp., 5-10=The percent of teachers with 5-10 years of experience in total teachers

Exp., more than 10=The percent of teachers with more than 10 years of experience in total teachers

Te/Pup=The ratio of teachers to Enroll x 100 (percent)

PFac/En=The percent of students in poor facilities in Enroll; includes students less than normal day, in excess of normal capacity, and in unsatisfactory rooms as determined by state standards.

Although not a direct School Input, the District variable is included as a rough measure of distinction among types of districts. Greater teacher degree and experience are expected to have positive impacts on school expenditures per student. Teachers with Bachelors' degrees and less than 1 year of experience are the control groups for degree and experience, respectively. A greater Te/Pup ratio is also expected to increase expenditures, while a higher PFac/En is expected to result in lower expenditures. Cohn (1), Katzman (5), and Riew (8) found that the quality of the teaching staff had a significant positive impact on school expenditures. Katzman and Riew found that variables representing teaching load, such as the pupil-teacher ratio (the inverse of Te/Pup) and courses taught per teacher, had a negative effect.

Student Characteristics are expected to affect school expenditures through their reflection of district attitudes toward education and the impact of these attitudes on the cost of producing a unit of education. The measures used in this study are:

En 69/67=The percent Enroll of enrollment in Spring 1967

En Sp/Au=The percent Enroll of enrollment in Autumn 1968

ADA/ADM=The percent of average daily attendance in average daily membership

Wh/TOT=The percent of white in total enrollment from a special survey (enrollment not identical with Enroll)

HS/TOT=The percent of high school student enrollment in Spring 1969 of Enroll.

Since school expenditure levels are likely to lag changes in enrollment, those districts experiencing higher growth rates (En 69/67) are expected to have lower per student expenditures. Or in recent years, those districts having greater enrollment declines are expected to have higher expenditures per pupil. The ratios En Sp/Au and ADA/ADM are both expected to have positive impacts on expenditures. Those districts which retain more students over the school year (higher En Sp/Au) and have more students in class on a daily basis (higher ADA/ADM) need more inputs to maintain classes. In addition, En Sp/Au and ADA/ADM may also act as partial measures of school quality; students stay in school more when quality is greater. This possibility further reinforces the expected positive impact of these measures on school expenditures.

The impact of Wh/TOT on expenditures is indeterminate. A district with more white students is expected to have higher expenditures because of differences in Wealth. However, many government programs add to expenditures most heavily in highly non-white districts. This in combination with the included measures of district Wealth may result in a negative impact of Wh/TOT on expenditures. The ratio HS/TOT is expected to have a positive impact on expenditures because expenditures per high school student are greater than per grade school student.

STATISTICAL ANALYSIS OF PUBLIC SCHOOL EXPENDITURES

Ordinary least squares estimates of equation (1) are presented in Table 5. All equations are quadratic in enrollment[4] and linear in all other variables. In equation (1.1), Y_1 is the dependent variable, while in (1.2) to (1.5) Y_2 is dependent where transportation costs are excluded. Equations (1.1) to (1.3) are for all districts, (1.4) is for city districts, and (1.5) for local districts. In equations (1.1) and (1.2), PFac/En and Student Characteristics are excluded. All equations have statistically significant F-ratios. The discussion focuses on equations (1.3), (1.4), and (1.5).

Based on the coefficients of Enroll and $(\text{Enroll})^2$, there is evidence of economies of scale up to about 6,500 students in the local equation (1.5), and slight diseconomies in the city equation (1.4) over the full range of city districts. However, in the state equation (1.3), the two enrollment coefficients are small and not significantly different from zero.

[4]Other functional forms used were the inverse of enrollment and the log of enrollment. The results were similar to those presented.

TABLE 5.—Estimates of School Expenditure Functions per Student, Ohio School Districts, 1968-69.†

	Equation				
	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)
Dependent	Y_1	Y_2	Y_2	Y_2	Y_2
Sample (Observations)	State (638)	State (638)	State (638)	City (168)	Local (420)
Intercept	—71.98	—75.63	155.30	—1,581.85	451.36
Enroll	0.24 (0.35)	0.32 (0.49)	—0.11 (0.17)	0.61 (1.09)	—13.11* (2.63)
$(Enroll)^2$	0.00 (0.40)	0.00 (0.39)	0.00 (0.51)	0.00 (0.44)	1.00** (1.89)
Tax Val.	5.01* (20.88)	4.79* (20.83)	4.62* (20.09)	3.54* (9.08)	4.53* (17.42)
Med Inc.	14.54* (3.27)	17.42* (4.08)	18.15* (4.33)	33.41* (5.20)	12.30* (2.38)
Med Ed.	12.26* (3.11)	11.24* (2.98)	10.77* (2.86)	1.74 (0.32)	11.28* (2.48)
District	4.38*** (1.46)	—3.27 (1.14)	—2.29 (0.82)		
Mas/TOT	4.20* (11.11)	4.18* (11.53)	4.06* (11.49)	3.96* (7.85)	2.67* (5.60)
ND/TOT	0.09 (0.27)	—0.15 (0.49)	—0.30 (1.01)	0.77 (1.04)	—1.12* (3.33)
Exp., 1-5	0.94** (1.89)	0.80** (1.67)	0.59 (1.27)	0.81 (0.87)	0.21 (0.40)
Exp., 5-10	1.32* (2.48)	1.33* (2.61)	1.09* (2.21)	2.11* (2.23)	1.48* (2.63)
Exp., more than 10	1.36* (3.13)	1.29* (3.11)	1.03* (2.53)	1.89* (2.46)	1.17* (2.51)
Te/Pup	34.34* (14.52)	35.26* (15.55)	38.72* (15.28)	116.01* (14.04)	29.18* (10.96)
PFac/En			—0.46* (2.75)	—0.42 (1.26)	—0.48* (2.68)
En 69/67			—0.36 (1.00)	—0.42 (0.64)	
En Sp/Au			2.28* (4.70)	9.01* (3.16)	1.32* (2.68)
ADA/ADM			—3.35** (1.88)	3.36 (0.98)	—4.68* (2.40)
Wh/TOT			—1.04* (3.84)	—0.51*** (1.51)	—0.74* (2.12)
HS/TOT			0.43*** (1.62)	—0.42 (1.00)	—0.17 (0.49)
R^2	0.763	0.789	0.807	0.933	0.749
Adjusted R^2	0.759	0.785	0.801	0.933	0.739
F	167.97*	194.65*	143.88*	123.72*	75.20*

Note: Y_1=Operating Expenses/ADM, Y_2=Y_1—Transportation Cost/ADM.

† t values in parentheses. Significance levels, two-tail t and F: *=.05 level, **=.10 level, ***=.20 level.

Of the Wealth variables, an increase of $1,000 in taxable property value per student increases expenditures by an estimated $4.62 per student in equation (1.3) of Table 5; the effect is greater in local than in city districts. With a simple correlation of 0.74, median income and median education are not fully separable in the equations. In the state equation (1.3), an increase of $1,000 in median income increases school expenditures by $18.15, and an increase of 1 year in median education by $10.77 per student. In the city equation (1.4), median income captures the full effect; the coefficient of median education is not significant. In the local equation (1.5), unit increases in these two variables have similar impacts on school expenditures. The combined effect of these two variables in city districts is about 50 percent greater than in local districts.

The coefficients of School Inputs are generally as expected. The coefficient of District is positive and significant in equation (1.1), but when transportation costs are excluded in equations (1.2) and (1.3), the coefficients are not significant.

Of the teacher characteristics, an increase of one percentage point in the proportion of teachers with Masters' degrees relative to teachers with Bachelor and 5-year degrees increases costs by about $4 per student in equation (1.3). Teachers without degrees reduce costs; local school districts have a much higher proportion of non-degree teachers (18 percent) as compared to city districts (8 percent). Teachers with 5-10 years of experience have the largest impact on costs relative to teachers with less than 1 year of experience.

An increase in the teacher-pupil ratio by 1 percentage point increases costs by $38.72 in the total sample, by $116.01 in city districts, and by $29.18 in local districts. A 1 percentage point increase in this ratio from its mean in 1968-69 would reduce the number of students per teacher from 21 to 17. The large coefficient for city districts may be due in part to the relatively high correlation of the teacher-pupil ratio with the Masters' total ratio (0.59) and the no-degree total ratio (—0.41). These respective correlation coefficients for the state and local districts are all less than 0.2 in absolute value. A greater proportion of students in poor facilities (PFac/En) reduces costs, as expected.

The Student Characteristics variables only partially conform to expectations. In equations (1.3) and (1.4) of Table 5 where it enters, the enrollment growth rate (En 69/67) has the expected negative effect on expenditures, but the coefficients are not statistically significant. The coefficients of the student retention rate (En Sp/Au) are positive and significant as expected, but those of the attendance rate (ADA/ADM) are not. It appears that higher attendance rates result in reductions of

non-classroom costs which exceed increases in classroom costs, particularly in local districts.

The coefficients of Wh/TOT are negative and significant in all equations. This is consistent with the expectation that special programs at the state and federal levels add most heavily to expenditures in highly non-white districts. The proportion of high school students (HS/TOT) has a positive significant effect on expenditures in equation (1.3), but is not significant in (1.4) and (1.5).

STATISTICAL ANALYSIS OF JOINT VOCATIONAL SCHOOL EXPENDITURES

Estimates of joint vocational school district expenditure functions for 1970-71 and 1971-72 are presented in Table 6. Four districts were excluded from the 1971-72 results because they were newly established. Enroll is fall enrollment rather than spring enrollment used in the regular school district equations. Diss/En is the percent of disabled students requiring special facilities to Enroll. Other variables used in the analysis but not included in the equations because they were not significant were teacher-pupil ratio, the number of classes-pupil ratio, and the percent of enrollment in each of the five program areas. These estimates must be interpreted with caution because of the recent establishment of most of these districts. The F-ratio of the 1971-72 equation is significant at only the 10 percent level.

The cost function estimates indicate increasing costs up to enrollment of 460 students in 1970-71 and 375 students in 1971-72, and declining costs with increasing size thereafter. Since these schools are relatively new, this increasing cost segment of the cost function may be

TABLE 6.—Estimates of Joint Vocational School District Expenditure Function per Student, Ohio, 1970-71 and 1971-72.†

	1970-71	1971-72
Intercept	769.001	772.957
Enroll	0.916**	0.750**
	(1.801)	(1.792)
$(Enroll)^2$	—0.001**	—0.001*
	(1.718)	(1.968)
Diss/En	25.175*	25.841*
	(2.783)	(2.344)
R^2	0.545	0.444
F	4.392*	2.928**
Observations	15	15

Note: Dependent variable is Y_2 =Operating Expenses/ADM —Transportation Cost/ADM.
† t values in parentheses. Significance levels, two-tail t and F: *=.05 level, **=.10 level.

due to a more rapid expansion of program than student body as these schools both establish their programs and their student bodies. The coefficients of Diss/En indicate that a 1 percentage point increase in disabled students increases costs per pupil by about $25 in both years. About 8 percent of the students were disabled in both years.

CONCLUSIONS AND IMPLICATIONS

The major conclusion of this study is that Ohio school districts have largely exhausted economies of scale from school operations. There is evidence of economies of scale in local districts and of diseconomies in city districts. When these are combined with exempted village districts for the total sample, there are no economies or disconomies of scale in the resulting estimates. In addition, local districts face the possibility that increases in transportation costs may exceed decreases in operation costs as size is expanded through consolidation.

While most previous studies have found economies of scale, the results of this study do not contradict them. Ohio school districts are large compared to the size of districts in previous studies. In 1968-69, local districts in Ohio had a mean enrollment of almost 1,900 students, and all districts in the state more than 3,500 students. These mean enrollment levels exceed the minimum cost enrollment estimates of all cited studies except Hanson (2) and Hirsch (3), who found no economies of scale. There are still opportunities for the consolidation of local districts to obtain operational economies and the establishment of county districts for administrative gains. From the view of Ohio as a whole, however, these gains will be small because most school districts are at or above efficient sizes of operation.

Economies of scale for joint vocational school districts need continuing study as these districts become established. In this study, economies of scale are found for joint vocational districts larger than about 400 students, but no optimum size of district is derivable from the estimates. While disabled students have a significant positive impact on costs, other factors expected to affect operating costs per pupil, such as the teacher-pupil ratio, are not significant.

With gains from economies of scale nearly exhausted in Ohio school districts, the search for gains in operational efficiency must focus on school inputs. While this is the subject of achievement studies and beyond the scope of this study, several possibilities are raised in conclusion. Achievement studies indicate that the teacher-pupil ratio has little impact on student achievement. The results of this study show that reducing this ratio by 1 percentage point (an increase in students per teacher from an average of 21 in 1968-69 to 25) would reduce operating expenditures per student by $29 to $116.

However, achievement studies have not been very successful in delineating the tradeoffs among school inputs. An increase in class size would be expected to reduce output per student. However, a more highly trained teacher might be able to maintain or increase output per student in a larger class as compared to a lesser trained teacher in a smaller class. While a more highly trained teacher would increase expenditures per student, the combination of larger classes and more highly trained teachers might both reduce expenditures and increase output per student. While answers to these and other similar issues are not yet definitive, further study of these issues appears to be the most promising direction for discovering additional gains in operational efficiency.

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North Appalachian Experimental Watershed, Coshocton, Coshocton County: 1047 acres (Cooperative with Agricultural Research Service, U. S. Dept. of Agriculture)

Northwestern Branch, Hoytville, Wood County: 247 acres

Pomerene Forest Laboratory, Coshocton County: 227 acres

Southern Branch, Ripley, Brown County: 275 acres

Western Branch, South Charleston, Clark County: 428 acres